

REPORT DOCUMENTATION PAGE				<i>Form Approved</i> OMB No. 0704-0188	
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1. REPORT DATE (DD-MM-YYYY) 26 Sep 2013		2. REPORT TYPE Consultative Letter		3. DATES COVERED (From – To) Feb 2013 – Jul 2013	
4. TITLE AND SUBTITLE CS-10 Verification Survey at Former McClellan AFB, Sacramento, CA				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Maj Alan Hale				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) USAF School of Aerospace Medicine Occupational and Environmental Health Dept Consultative Services Division 2510 Fifth St. Wright-Patterson AFB, OH 45433-7913				8. PERFORMING ORGANIZATION REPORT NUMBER AFRL-SA-WP-CL-2013-0019	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSORING/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Distribution A: Approved for public release; distribution is unlimited. Case Number: 88ABW-2013-4214, 26 Sep 2013					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT At the request of the U.S. Air Force Radioisotope Committee Secretariat (RICS), the U.S. Air Force School of Aerospace Medicine, Consultative Services Division completed an independent radiological assessment/verification survey from 20-22 Feb 2013 at site CS-10 on former McClellan AFB, CA. Radium-226 was the sole radionuclide of concern. Cabrera Services, Inc., under contract with URS, conducted all radiological field work to include the Final Status Survey (FSS). This letter details the findings of this visit and is meant to assist the RICS when evaluating the contractor's FSS report of this site.					
15. SUBJECT TERMS USAF School of Aerospace Medicine (USAFSAM), former McClellan AFB, radium-226, verification survey, final status survey, independent radiological assessment					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			Col Mark E. Smallwood
					19b. TELEPHONE NUMBER (include area code)



DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
WRIGHT-PATTERSON AFB OH

26 September 2013

MEMORANDUM FOR AFMSA/SG3PB

ATTN: MAJ DANIEL SHAW
USAF RADIOISOTOPE COMMITTEE SECRETARIAT
AIR FORCE MEDICAL SUPPORT AGENCY
7700 ARLINGTON BOULEVARD, SUITE 5158
FALLS CHURCH, VA 22042-5158

FROM: USAFSAM/OEC
2510 Fifth Street
Wright-Patterson AFB, OH 45433-7913

SUBJECT: Consultative Letter, AFRL-SA-WP-CL-2013-0019, CS-10 Verification Survey at
Former McClellan AFB, Sacramento, CA

1. INTRODUCTION:

a. *Purpose:* At the request of the U.S. Air Force Radioisotope Committee Secretariat (RICS), the U.S. Air Force School of Aerospace Medicine, Consultative Services Division (USAFSAM/OEC) completed an independent radiological assessment/verification survey from 20-22 Feb 2013 at site CS-10 on former McClellan AFB, CA. Radium-226 (Ra-226) was the sole radionuclide of concern. Cabrera Services, Inc., under contract with URS, conducted all radiological field work to include the Final Status Survey (FSS). This letter details the findings of this visit and is meant to assist the RICS when evaluating the contractor's FSS report of this site.

b. *Background:* The regulators chose an unrestricted release cleanup criteria of 2.0 pCi/g of Ra-226. The unrestricted release criteria were based upon social, economic, political, and health factors.

c. *Survey Personnel:*

- (1) Health Physicist, USAFSAM/OEC
- (2) Health Physics Technician, USAFSAM/OEC

d. *Personnel Contacted:*

- (1) Radiation Safety Officer, AFCEC/CIBW

(2) Radiation Project Manager, Cabrera Services, Inc.

e. *Radiation Measurement Equipment:*

- (1) Ludlum Meter Model 2221 (SN 169220, Calibrated 8 Jan 2013, Calibration Due 8 Jan 14)
- (2) Ludlum Meter Model 2221 (SN 78153, Calibrated 9 Jan 2013, Calibration Due 9 Jan 14)
- (3) Scionix Probe Model 76BRS78/3M-E1-X (SN SAG411, Calibrated 8 Jan 2013, Calibration Due 8 Jan 14)
- (4) Scionix Probe Model 76BRS78/3M-E1-X (SN SAG419, Calibrated 9 Jan 2013, Calibration Due 9 Jan 14)

2. METHODOLOGY:

a. *Site Layout:* The CS-10 site as surveyed comprised an excavated landfill that had a weatherization tent covering it. The area is approximately 2.6 acres (see Figures 1-3 below).



Figure 1. Exterior View



Figure 2. Interior View, Facing North



Figure 3. Interior View, Facing South

b. *Process:* The verification survey consisted of gamma walkovers and biased soil sampling. The goals of the walkover survey were to detail site radiological conditions, identify potential spots of elevated residual Ra-226 concentrations, and identify locations for biased soil sampling. This verification survey required at least 10% of the floor area to be scanned by the gamma walkover technique and soil sampling totaling at least 10% of the number of measurements taken by the contractor. Since the gamma walkover data were to qualitatively assess the site in terms of mean reading plus amount of standard deviation, minimum detectable concentration and count rates were not calculated.

c. *Gamma Walkover Survey:* The sodium iodide detectors used were Scionix 76BRS78/3M-E1-X 3x3-inch detectors coupled with a Ludlum 2221 Ratemeter/Scaler. For walkover surveys, the Ludlum 2221 was connected via cable to a Trimble GeoXT handheld GPS unit. The Trimble GeoXT logged the count rates with the corresponding GPS coordinates every second. The detector was held at 10 cm above the ground during walkover surveys. Additionally during walkovers, the scan speed was approximately 0.5 m/s, where the line spacing was approximately 0.5 m. All field instruments were function checked and field tested before and after use with a check source. All instruments were tested to ensure a 20% tolerance during field checks. All instruments are calibrated on an annual basis at WPAFB, OH. Attachment 1 contains all annual calibration sheets, and Attachment 2 is the Radiation Meter Quality Control Log.

d. *Soil Sampling:* Each sample was taken from an area of about 8 in² to a depth of 6 in. The volume sampled was enough for laboratory analysis (approximately 0.25 gal). Field soil sampling procedures were in place to prevent cross-contamination of samples. Soil samples were counted at the USAFSAM Radioanalytical Laboratory (OEAL) at WPAFB, OH. The soil was counted on a high purity germanium detector. The soils were also analyzed by OEAL using the appropriate in-growth method to determine Ra-226 levels in soil.

3. RESULTS:

a. *Gamma Walkover Survey:* The CS-10 site area of approximately 2.6 acres was characterized with a sodium iodide detector using a gamma walkover technique. Scan coverage was approximately 100% of the accessible floor, which exceeded the 10% scan requirement. During the course of the gamma walkover survey, three localized hot spots were detected. The contractor was notified and the three localized hot spots were remediated prior to completion of the USAFSAM walkover survey and soil sampling. The three localized hot spots were in the vicinity of soil sample numbers GS130014, GS130010, and GS130007. After the contractor's spot remediation, the areas were rescanned. The gamma walkover survey plots can be found in Figures 4, 5, and 6 (soil sample locations are indicated with an "x"). Figure 4 is the plot of the data prior to spot remediation done by the contractor; soil sampling locations are marked on the plot for reference, but soil sampling was not completed until the areas were remediated by the contractor. Figure 5 is the gamma walkover survey plot in the vicinity of soil sample locations GS130007 and GS130010, post contractor remediation. Figure 6 is the gamma walkover survey plot in the vicinity of soil sample location GS130014, post contractor remediation. The mean count rate of the scanned area itself and its associated statistics were used to determine the "background" for this scanned area. The mean and standard deviation were calculated based upon the instrument used, the day, exclusion of data outside the "background" distribution, and in some instances the particular area surveyed. These aggregated

data were used to produce Figures 4, 5, and 6. The lowest readings of the survey are marked in green and correspond to less than two standard deviations above the mean background value. This green area is where soil concentrations are expected to be the lowest. The other colors represent areas of statistical significance where higher concentrations are expected to be found. Yellow and red colors correspond to greater than two and three standard deviations, respectively, above the mean count rate value. The color scheme demonstrates a scale of instrument data based upon standard deviations from background, where no regulatory values are implied.

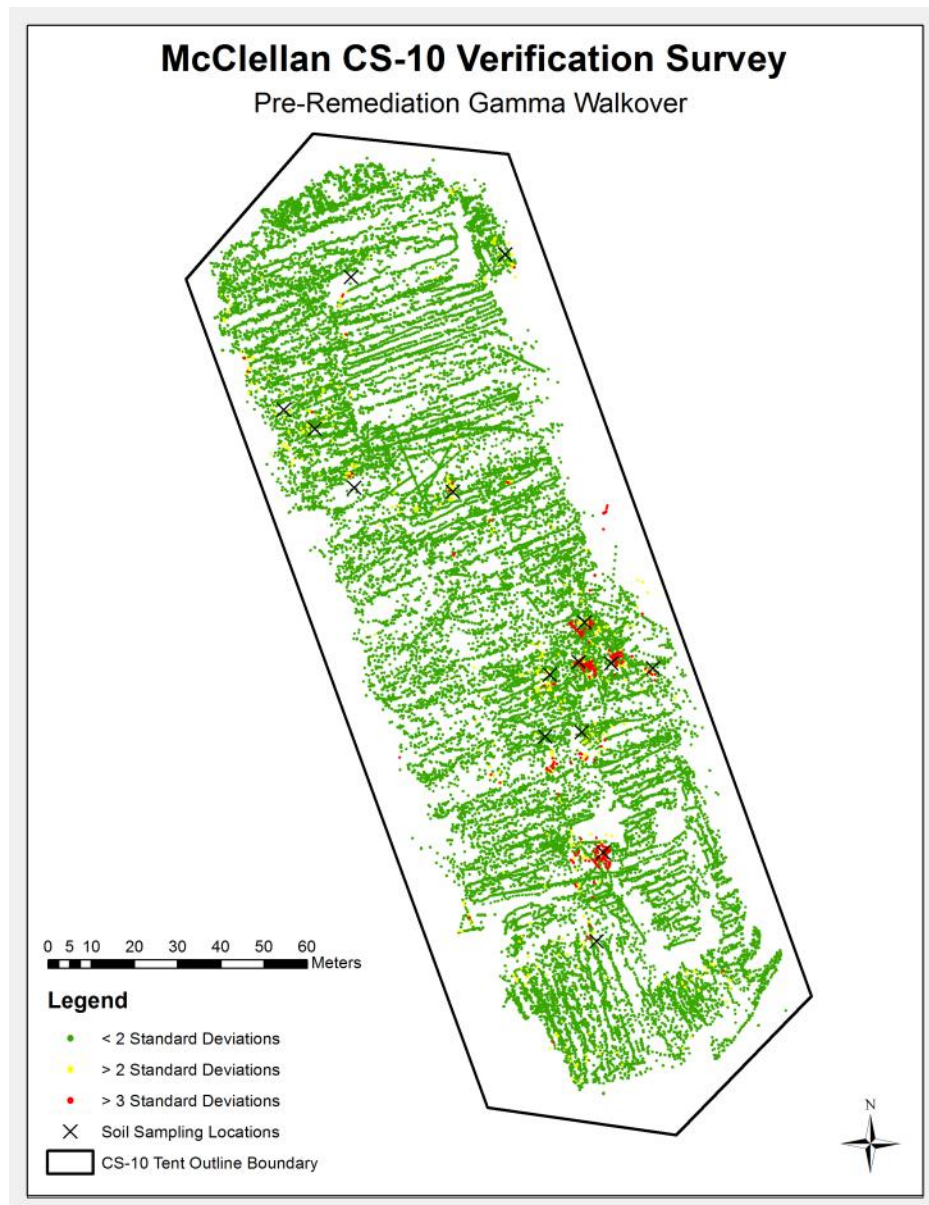


Figure 4. CS-10 Pre-Remediation Gamma Walkover Plot

McClellan CS-10 Verification Survey

Post-Remediation Gamma Walkover
Vicinity of Samples GS130007 through GS130012

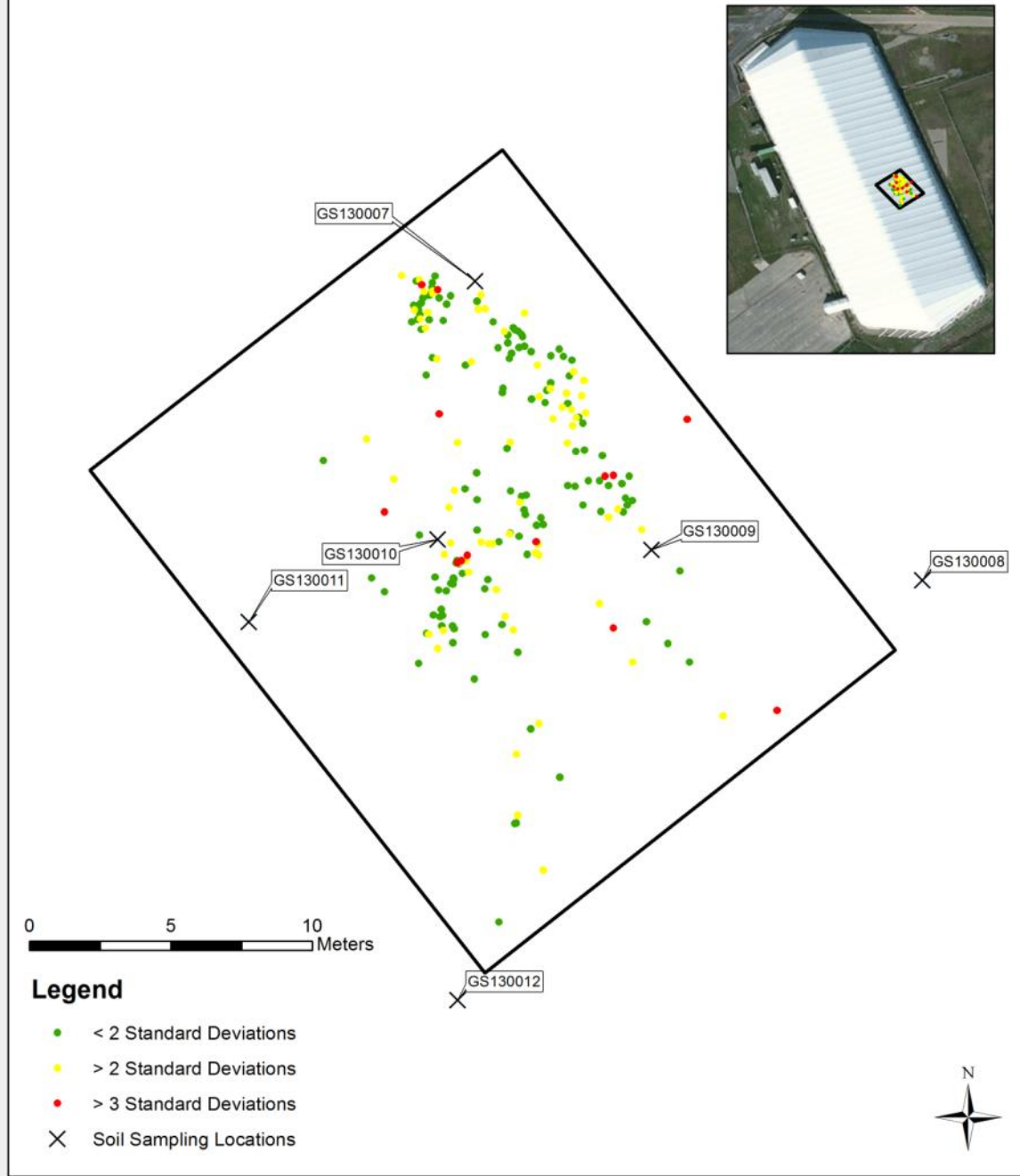


Figure 5. CS-10 Post-Remediation Gamma Walkover Plot, Area of GS130007 Through GS130012

McClellan CS-10 Verification Survey

Post-Remediation Gamma Walkover - Vicinity of Sample GS130014

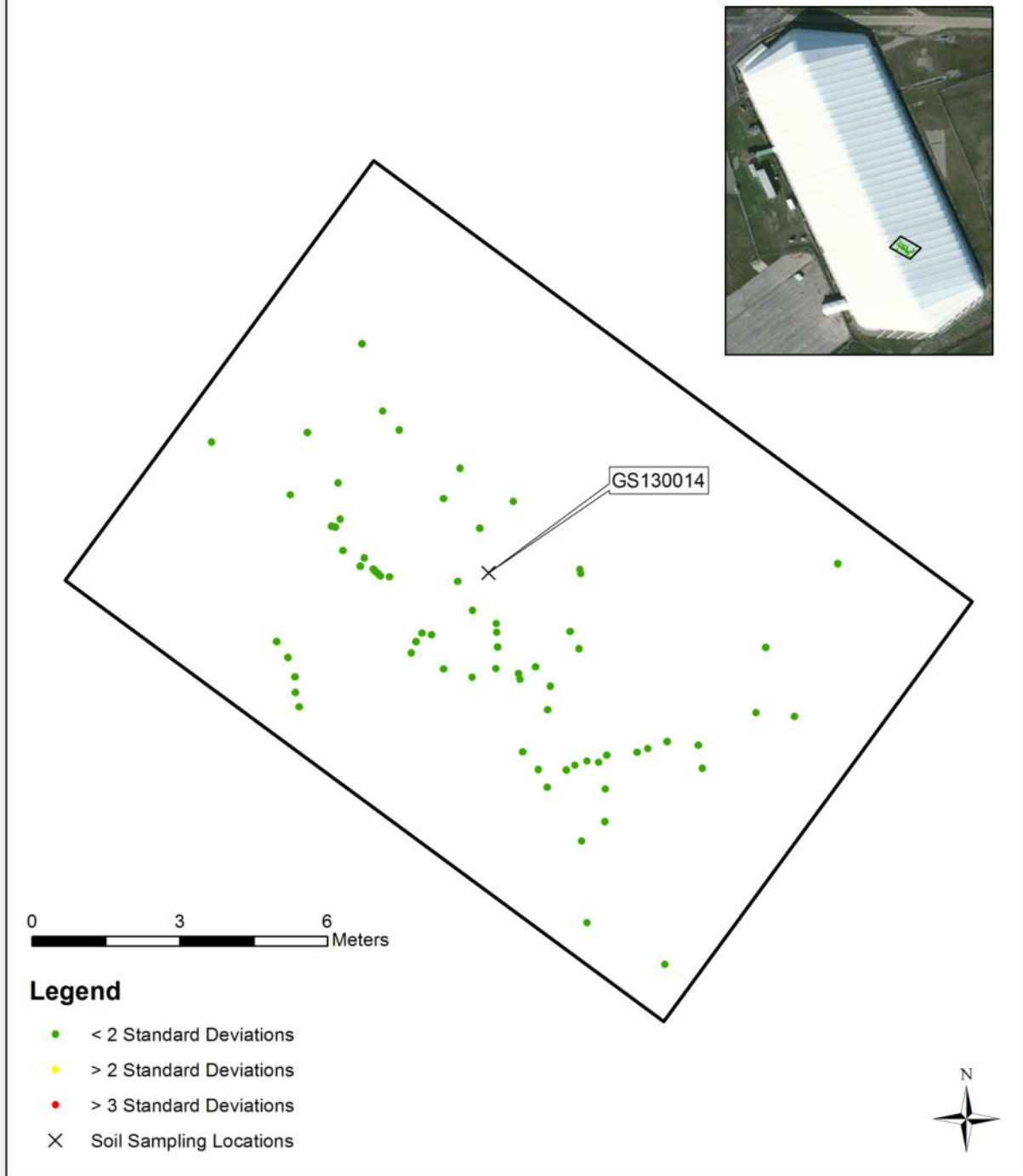


Figure 6. CS-10 Post-Remediation Gamma Walkover Plot, Area of GS130014

b. *Soil Samples*: Fifteen floor soil samples were taken at the CS-10 site. Since the contractor collected 44 soil measurements of the CS-10 floor, 15 biased soil samples were collected that exceeded the 10% requirement. The gross Ra-226 soil concentration results are in Table 1, which is inclusive of the background Ra-226 concentration and can be compared directly to the cleanup goal of 2.0 pCi/g. The uncertainties listed are at the 95% confidence levels. The soil samples were collected after the contractor's spot remediation of the three localized hot spots found during the gamma walkover survey. Nine of the 15 soil samples exceeded the cleanup goal of 2.0 pCi/g. The soil laboratory analysis data are included in Attachment 3. Note that the total Ra-226 was taken as the "Ra_D_214" since the Ra-226 concentrations were determined by gamma spectral analysis of the Ra-226 progeny. The locations and results of the soil samples are also plotted in Figure 7 (soil sample locations are indicated with an "x").

Table 1. Soil Sample Results for CS-10

Sample #	GPS Coordinates (°N, °E)	Gross Ra-226 Concentration (pCi/g)
GS130001	38.664072663, -121.412217552	2.275 ± 0.076
GS130002	38.664035663, -121.412538604	1.212 ± 0.064
GS130003	38.663820136, -121.412678263	1.607 ± 0.061
GS130004	38.663789091, -121.412613689	2.222 ± 0.072
GS130005	38.663693377, -121.412531095	5.50 ± 0.13
GS130006	38.663687025, -121.412325682	1.953 ± 0.07
GS130007	38.663474969, -121.412052596	29.08 ± 0.44
GS130008	38.663400777, -121.411910375	1.078 ± 0.049
GS130009	38.663408305, -121.411996553	1.857 ± 0.071
GS130010	38.663410865, -121.412064481	5.70 ± 0.12
GS130011	38.663390380, -121.412124643	3.460 ± 0.099
GS130012	38.663296601, -121.412058151	5.62 ± 0.15
GS130013	38.663289890, -121.412134402	3.88 ± 0.11
GS130014	38.663101370, -121.412013677	56.34 ± 0.69
GS130015	38.662956966, -121.412027424	0.808 ± 0.049

McClellan CS-10 Verification Survey

Soil Sample Locations and Results

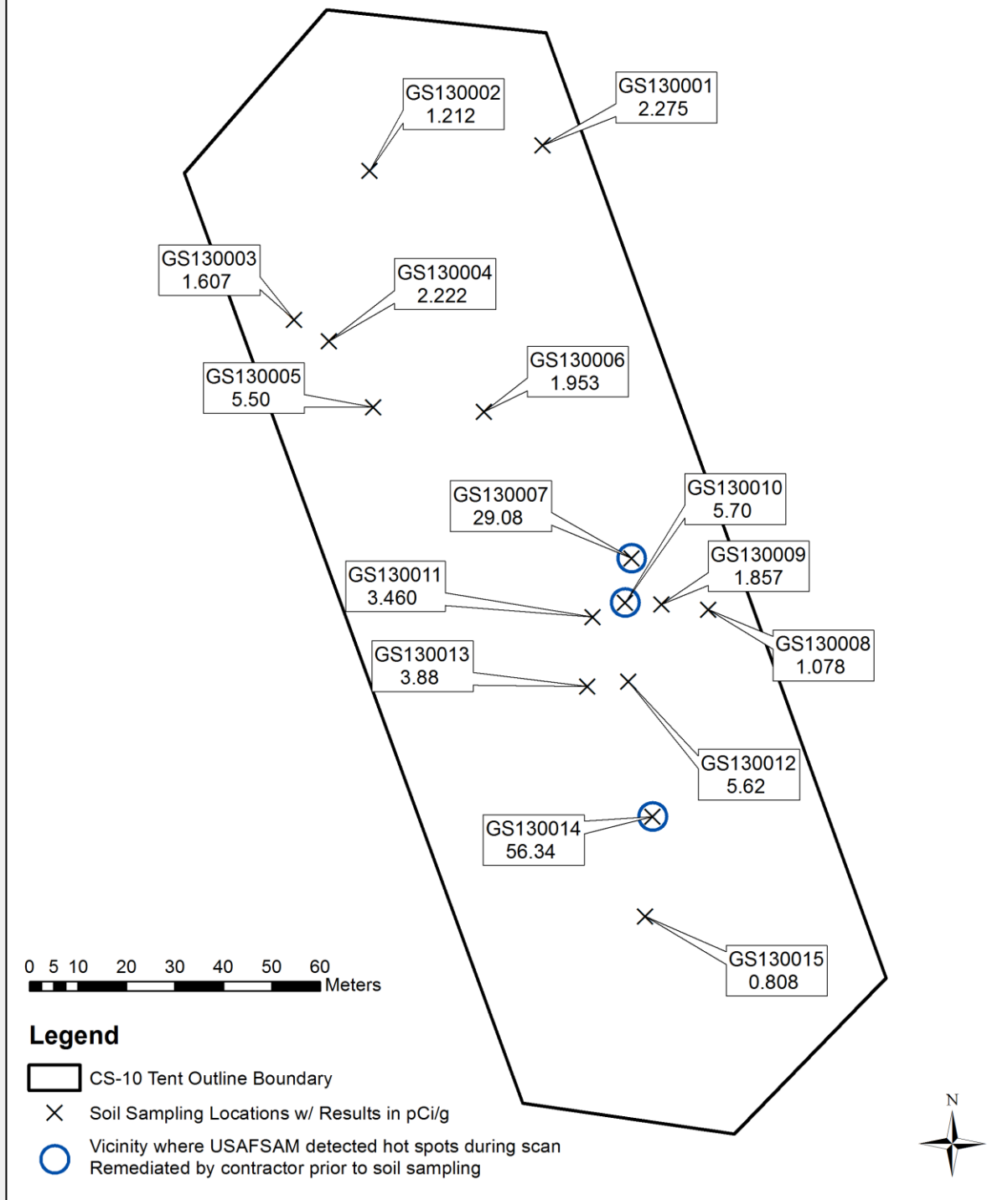


Figure 7. CS-10 Soil Sampling Locations

4. DISCUSSION:

a. There is agreement between the contractor's revised draft April 2013 gamma scan survey results and USAFSAM's gamma scan results. However, the major disparity in USAFSAM's and the contractor's data is in USAFSAM's soil sampling results and the contractor's in-situ gamma spectroscopy results for Ra-226 soil concentrations. The in-situ gamma spectroscopy uses a different analysis technique and has a larger averaging area. In the case of localized contamination, soil samples undergoing laboratory analysis may lead to higher concentration levels than in-situ gamma spectroscopy.

b. All soil samples were taken in biased locations where elevated Ra-226 concentrations were expected to be found. Nine of the 15 biased soil samples exceeded the cleanup goal of 2.0 pCi/g. Two of the soils sample results, measuring 29.08 ± 0.44 pCi/g and 56.34 ± 0.69 pCi/g, significantly exceeded the cleanup goal. Since all soil samples were biased samples, the mean concentration cannot be determined. Also based on these biased samples, one cannot determine if the cleanup criteria were met for unrestricted release.

c. USAFSAM collected soil samples for analysis on 22 Feb 2013 and additional remediation may have been since completed at the site by the contractor, so the values may not reflect the conditions measured in the contractor's FSS report.

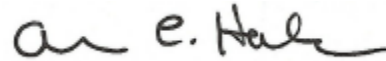
d. The areas that were remediated prior to soil sampling yielded some of the highest soil sampling results. However after rescanning these areas, based upon the statistical significance of the scan walkover data, the rescan results would not necessarily indicate levels of contamination greater than 2 pCi/g. The walkover gamma technique is valid for screening with limitations; scanning limitations may include possible heterogeneity, scan sensitivity, and depth of burial of contamination. However, laboratory analysis is the definitive indicator of site conditions for regulatory decisions.

5. CONCLUSIONS AND RECOMMENDATIONS:

a. Based upon the findings of this verification survey, localized areas did exceed the cleanup goal of 2 pCi/g; however, the overall site conditions may be suitable for unrestricted release criteria. The soil sample results were shared with RICS prior to the publication of this letter for RICS' immediate use and action. RICS subsequently shared the results with the contractor, and based upon USAFSAM soil sample results, RICS and the contractor determined a path forward of additional contractor-led remediation, sampling, and scanning to ensure that the site met unrestricted release criteria.

b. During the writing of this letter, all of the contractor additional action results were not finalized; therefore, USAFSAM recommends RICS carefully reviews the final contractor's FSS report for CS-10 before the site is approved for unrestricted free release of radiological controls.

6. If you have any questions regarding this report, please contact Maj Alan Hale at 937-938-3320 (DSN 798-3320) or alan.hale@us.af.mil.

A handwritten signature in black ink, appearing to read "a. e. Hale".

ALAN C. HALE, Maj, USAF, BSC
Chief, Radiation Consulting Branch

3 Attachments:

1. Instrument Calibration Sheets
2. Radiation Meter Quality Control (QC) Log
3. Laboratory Soil Analysis

Attachment 1

Instrument Calibration Sheets



**DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
OCCUPATIONAL ENVIRONMENTAL HEALTH
WRIGHT-PATTERSON AFB OHIO
CERTIFICATE OF CALIBRATION**

Mfg. Ludlum Model 2221 Serial # 169220 Index # 102239 Date: 08-Jan-13
Mfg. Scionix Model 70BR570 3M-E1-X Serial # SAG411 Index # N/A Cal. Due Date: 08-Jan-14

TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT

NIST Traceable Check Sources

Isotope	Serial #	Cert. Date	DPM
Cs-137	RP3067	01-Nov-04	2040446
N/A			

Reference Instruments

Mfg.	Model	Serial #	Cal. Due Date
Ludlum	500-1	102951	14 FEB 2013

Measurement Standards and test equipment used are traceable to the National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facilities.

☒ Battery Ck. ☒ Mechanical Ck. ☒ Meter Zeroed ☒ Reset Ck. ☐ Alarm Ck.
☒ Audio Ck. ☒ Geotropism Ck. ☒ F/S Resp. Ck. ☒ Window Op.

As Found HV 1,143 VDC Temperature 70.7 °F Relative Humidity 26.4 %

Final Volt. Set 725 VDC Threshold (LLD) 10 mV Window (ULD) 20 mV Window width 10 mV

HV Readout (2 points) Reference: 500 V Reference: 1000 V
Inst. Readout: 498 V ± 2% Inst. Readout: 1,000 V ± 2%

RANGE MULTIPLIER	REFERENCE CAL. POINT	"AS FOUND" READING	CORRECTED READING
x 1000	400 CPM	400,000 CPM	400,000 CPM
x 1000	100 CPM	100,000 CPM	100,000 CPM
x 100	400 CPM	40,000 CPM	40,000 CPM
x 100	100 CPM	10,000 CPM	10,000 CPM
x 10	400 CPM	4,100 CPM	4,000 CPM
x 10	100 CPM	1,100 CPM	1,000 CPM
x 1	400 CPM	400 CPM	400 CPM
x 1	100 CPM	100 CPM	100 CPM
Log Scale	200 CPM	200 CPM	200 CPM

DIGITAL SCALER READOUT

CAL. REF. POINT	AS FOUND READING	CORRECTED READING
40,000 CPM	39,995 CPM	39,995 CPM

*UNCERTAINTY WITHIN ± 10% CORRECTION FACTOR WITHIN ± 20%

COMMENTS: Calibration Interval = 1 year Use "Window OUT"

Detector Parameters: Pg 2-3

Procedural Authority - ICP#22210000

Calibrated By: Cesar A. Valverde

Date: 08-Jan-2013

Reviewed By: [Signature]

Date: 10 Jan 13

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WRIGHT-PATTERSON AFB OHIO
CERTIFICATE OF CALIBRATION

Meter _____ Date: 08-Jan-13
Mfg. Ludlum Model 2221 Serial # 169220 Index # 102239 Cal. Due Date: 08-Jan-14

TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT

NIST Traceable Check Sources

Isotope	Serial #	Cert. Date	DPM
Cs-137	RP3067	01-Nov-04	2040446
N/A			

Reference Instruments

Mfg.	Model	Serial #	Cal. Due Date
Ludlum	500-1	102951	14 FEB 2013

Measurement Standards and test equipment used are traceable to the National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facilities.

NaI DETECTOR HIGH VOLTAGE OPTIMIZATION

Probe #1

Mfg. Scionix
Model 76BR576 3M-E1-X
Serial # SAG411
Index # N/A
Isotope: Cs-137 @ 6"

Probe #2

Mfg. N/A
Model _____
Serial # _____
Index # _____
Isotope: _____

Probe #3

Mfg. N/A
Model _____
Serial # _____
Index # _____
Isotope: _____

High Voltage	CPM
500	27538
550	29113
600	28675
650	29611
700	29936
*725	29032
750	29433
800	30684
850	34332
900	47875
950	128179
-----	-----
Bkgd@ 725v	9,836

High Voltage	CPM

High Voltage	CPM

Final Volt. Set 725 VDC Final Volt. Set _____ VDC Final Volt. Set _____ VDC
Efficiency 9,500 CPM/ μ ci/m² @12" Efficiency _____ CPM/ μ ci/m² @12" Efficiency _____ % 2 π @1/4"

COMMENTS: Calibration Interval = 1 year Use "Window OUT "

Calibrated By: Cesar A. Valverde
Reviewed By: P. W. W.

Date: 08-Jan-2013
Date: 10 Jan 13

Pg 2 of 3

Jan 08 2013 03 04 PM Cesar A. Valverde
HotSpot FIDLER Calibration Information

Report Date : Jan 08 2013 03:04 PM
Calibration Date : 8 Jan 2013
Target Mix : Other Nuclide Check Source
Radionuclide : Cs-137
Detector Barcode Number :
Meter Barcode Number : 05682
Detector Manufacturer : Scionix
Detector Model Number : 76BR576 3ME1-X
Detector Serial Number : SAG 411
Meter Manufacturer : Ludlum
Meter Model Number : 2221
Meter Serial Number : 169220

Check Source I.D. : RP741
Calibration Date : 8 Jan 2013
Calibrated by : Cesar A. Valverde
Check Source Activity (uCi): 1.110E+00

Sample Counting Time (minutes) : 1.000E+00
Detector Height (cm) : 3.000E+01

Cs-137 window Information:

Background (cpm) : 9,836
Areal Limit of Sensitivity (uCi/m2) : 4.9E-02
Point Limit of Sensitivity (uCi) : 7.3E-02
K-factor (m2) : 1.50

Counting Data (counts):

0-cm: 16851
20-cm: 15180
40-cm: 13092
60-cm: 11807
80-cm: 11149
100-cm: 10711

Instrument Type : Other

Window Option: Only 60 keV

Units: Classic

This is an actual 3x3 calibration, and the values are typical of most 3x3 configurations.

Detector Calibration Results

Cs-137 window Information:

Cs-137 Detector Efficiency (cpm/(uCi/m2)): 9.5E+03
Cs-137 Detector Areal LOS (uCi/m2) : 4.9E-02
Cs-137 Detector Point LOS (uCi) : 7.3E-02
Cs-137 Detector Background Rate (cpm) : 9,836
Cs-137 Detector Check Source Rate (cpm) : 7,015
Cs-137 Detector K-Factor (m2) : 1.50
Cs-137 Detector K-Factor sdev (%) : 5.2

Cs-137 Eff: 9500 cpm/uCi/m² 2" @ 12"



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WRIGHT-PATTERSON AFB OHIO
CERTIFICATE OF CALIBRATION

Mfg. Ludlum Model 2221 Serial # 78153 Index # 04125 Date: 09-Jan-13
Mfg. Scionix Model 76BR57B/3M-E1-X Serial # SAG 419 Index # N/A Cal. Due Date: 09-Jan-14

TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT

NIST Traceable Check Sources

Isotope	Serial #	Cert. Date	DPM
Cs-137	RP 3067	01-Nov-04	2040325
N/A			

Reference Instruments

Mfg.	Model	Serial #	Cal. Due Date
Ludlum	500-1	102951	14 FEB 2013

Measurement Standards and test equipment used are traceable to the National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facilities.

☒ Battery Ck. ☒ Mechanical Ck. ☒ Meter Zeroed ☒ Reset Ck. ☐ Alarm Ck.
☒ Audio Ck. ☒ Geotropism Ck. ☒ F/S Resp. Ck. ☒ Window Op.

As Found HV 1,237 VDC Temperature 69.8 °F Relative Humidity 34.2 %

Final Volt. Set 725 VDC Threshold (LLD) 10 mV Window (ULD) 19 mV Window width 9 mV

HV Readout (2 points) Reference: 500 V Reference: 1000 V
Inst. Readout: 500 V \pm 2% Inst. Readout: 1,004 V \pm 2%

RANGE MULTIPLIER	REFERENCE CAL. POINT	"AS FOUND" READING	CORRECTED READING
x 1000	400 CPM	410,000 CPM	400,000 CPM
x 1000	100 CPM	101,000 CPM	100,000 CPM
x 100	400 CPM	40,000 CPM	40,000 CPM
x 100	100 CPM	10,000 CPM	10,000 CPM
x 10	400 CPM	4,000 CPM	4,000 CPM
x 10	100 CPM	1,000 CPM	1,000 CPM
x 1	400 CPM	410 CPM	400 CPM
x 1	100 CPM	110 CPM	100 CPM
Log Scale	200 CPM	200 CPM	200 CPM

DIGITAL SCALER READOUT

CAL. REF. POINT	AS FOUND READING	CORRECTED READING
40,000 CPM	39,962 CPM	39,962 CPM

*UNCERTAINTY WITHIN \pm 10% CORRECTION FACTOR WITHIN \pm 20%

COMMENTS: Calibration Interval = 1 year Use "Window OUT"

Detector Parameters: Pg 2-3

Procedural Authority - ICP#22210000

Calibrated By: Cesar A. Valverde
Reviewed By: P. W. W.

Date: 09-Jan-2013

Date: 10 Jan 13

Pg 1 of 3



DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
OCCUPATIONAL ENVIRONMENTAL HEALTH
WRIGHT-PATTERSON AFB OHIO
CERTIFICATE OF CALIBRATION

Meter _____ Date: 09-Jan-13
Mfg. Ludlum Model 2221 Serial # 78153 Index # 04125 Cal. Due Date: 09-Jan-14

TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT

NIST Traceable Check Sources

Isotope	Serial #	Cert. Date	DPM
Cs-137	RP3067	01-Nov-04	2040325

Reference Instruments

Mfg.	Model	Serial #	Cal. Due Date
Ludlum	500-1	102951	14 FEB 2013

Measurement Standards and test equipment used are traceable to the National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facilities.

NaI DETECTOR HIGH VOLTAGE OPTIMIZATION

Probe #1

Mfg. Scionix
Model 76BRS76/ 3M-E1-X
Serial # SAG 419
Index # N/A
Isotope: Cs-137 @ 6"

Probe #2

Mfg. N/A
Model _____
Serial # _____
Index # _____
Isotope: _____

Probe #3

Mfg. N/A
Model _____
Serial # _____
Index # _____
Isotope: _____

High Voltage	CPM
500	27248
650	28548
600	28415
650	29471
700	29304
*725	29529
750	29204
800	29784
850	22928
900	63026
950	200948
-----	-----
Bkgd @ 725v	10,030

High Voltage	CPM

High Voltage	CPM

Final Volt. Set 725 VDC Final Volt. Set _____ VDC Final Volt. Set _____ VDC
Efficiency 11000 CPM/ μ ci/m² @12" Efficiency _____ CPM/ μ ci/m² @12" Efficiency _____ % 2 π @1/4"

COMMENTS: Calibration Interval = 1 year Use "Window OUT "

Calibrated By: Cesar B. Valverde
Reviewed By: P. Miller

Date: 09-Jan-2013
Date: 10 Jan 13

Pg 283

Jan 09 2013 01 20 PM Cesar A. Valverde
HotSpot FIDLER Calibration Information

Report Date : Jan 09 2013 01:20 PM
Calibration Date : 8 Jan 2013
Target Mix : Other Nuclide Check Source
Radionuclide : Cs-137
Detector Barcode Number :
Meter Barcode Number : 04125
Detector Manufacturer : Scionix
Detector Model Number : 76BR576 3M-E1-X
Detector Serial Number : SAG 419
Meter Manufacturer : Ludlum
Meter Model Number : 2221
Meter Serial Number : 78153

Check Source I.D. : 3067
Calibration Date : 8 Jan 2013
Calibrated by : Cesar A. Valverde
Check Source Activity (uCi): 1.110E+00

Sample Counting Time (minutes) : 1.000E+00
Detector Height (cm) : 3.000E+01

Cs-137 window Information:

Background (cpm) : 10,030
Areal Limit of Sensitivity (uCi/m2) : 4.3E-02
Point Limit of Sensitivity (uCi) : 7.4E-02
K-factor (m2) : 1.72

Counting Data (counts):

0-cm: 17030
20-cm: 15596
40-cm: 13232
60-cm: 11858
80-cm: 11203
100-cm: 10892

Instrument Type : other

Window Option: Only 60 keV

Units: Classic

This is an actual 3x3 calibration, and the values are typical of most 3x3 configurations.

Detector Calibration Results

Cs-137 window Information:

Cs-137 Detector Efficiency (cpm/(uCi/m2)): 1.1E+04
Cs-137 Detector Areal LOS (uCi/m2) : 4.3E-02
Cs-137 Detector Point LOS (uCi) : 7.4E-02
Cs-137 Detector Background Rate (cpm) : 10,030
Cs-137 Detector Check Source Rate (cpm) : 7,000
Cs-137 Detector K-Factor (m2) : 1.72
Cs-137 Detector K-Factor sdev (%) : 5.2

Cs-137 Eff: 11000 cpm/uCi/m² 20@12"

Radiation Meter QC Log

Radiation Meter QC Log

Distribution A: Approved for public release; distribution is unlimited. Case Number: 88ABW-2013-4214, 26 Sep 2013

Attachment 3 Laboratory Soil Analysis



MEMORANDUM FOR: Maj Alan Hale
USAFSAM/OEC
2510 Fifth St. Bldg. 840
WRIGHT-PATTERSON AFB, OH 45433

5/10/2013 1:07:14 PM

FROM: USAFSAM OE Industrial Hygiene
2510 Fifth Street, Bldg 20840, Room W327
Wright Patterson Air Force Base, OH 45433-7913

REF: Order No.: S1302201

Dear Maj Alan Hale:

Enclosed are the sample reports from 15 samples received on 2/25/2013.

Samples, not consumed in analysis, will be held according to the appropriate regulatory authority unless you specifically request otherwise. Should you choose to reproduce this report, we recommend you do so in its entirety so that the integrity of the data package is kept intact.

If you have questions, or if we may be of further assistance to you, please do not hesitate to contact us.

Sincerely,

ERIC L WEATHERHOLT, Capt, USAF
Analytical Services Program Manager
Tel: (937) 938-2523 (DSN Prefix: 798)
<https://kx.afms.mil/chemlab>

Note: Sample analysis performed by: USAFSAM/OE Radioanalytical Division

This report is intended solely for the purpose of the person to whom it is addressed. If received in error, please notify the Program Manager listed above.

USAFSAM OE Industrial Hygiene

CLIENT: USAFSAM/OEC

Project:

Lab Work Order: S1302201

CASE NARRATIVE

There were no problems associated with the samples or analysis except where noted below. Unless otherwise noted, sample results are not blank corrected, and all quality control associated with the samples were within acceptable limits.

These results relate only to the items tested.

Radium 226 results should be interpreted by reviewing the Ra_D_214 results.



Radioanalytical Services Laboratory
2510 Fifth St, Area B Bldg 0840 WPAFB, OH 45433 - (937) 938-2523

Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
Report Date: 5/10/2013 1:07:14 PM
WRIGHT-PATTERSON AFB OH, 45433
Contact: Maj Alan Hale
Client Sample ID: GS130001
Lab Sample ID: S1302201-01A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
U-235		2.4E-1	5.E-2	4.E-2	8.E-2	pCi/g	TDR	04/23/13 1100	6282
TL-208		3.1E-1	4.E-2	2.E-2	5.E-2	pCi/g	TDR	04/23/13 1100	6282
TH-234		2.E0	2.E0	3.E0	5.E0	pCi/g	TDR	04/23/13 1100	6282
TH-232		3.0E1	2.0E1	2.0E1	4.0E1	pCi/g	TDR	04/23/13 1100	6282
RA-226		3.8E0	8.E-1	6.E-1	1.3E0	pCi/g	TDR	04/23/13 1100	6282
RA-224		1.8E0	5.E-1	4.E-1	8.E-1	pCi/g	TDR	04/23/13 1100	6282
Ra_D_214		2.275E0	7.6E-2	4.5E-2	9.3E-2	pCi/g	TDR	04/23/13 1100	6282
PB-214		1.8E0	3.E-1	3.E-1	5.E-1	pCi/g	TDR	04/23/13 1100	6282
PB-212		1.06E0	6.E-2	4.E-2	9.E-2	pCi/g	TDR	04/23/13 1100	6282
K-40		1.5E1	1.E0	0.E0	1.E0	pCi/g	TDR	04/23/13 1100	6282
BI-212		6.E-1	4.E-1	3.E-1	7.E-1	pCi/g	TDR	04/23/13 1100	6282
AC-228		1.00E0	8.E-2	8.E-2	1.8E-1	pCi/g	TDR	04/23/13 1100	6282

BRIAN J STROH, Capt, USAF
Chief, Radioanalytical Laboratory

AURELIE M SOREFAN, DR-II, PhD, DAF
Technical Director, Radioanalytical Laboratory



Radioanalytical Services Laboratory
2510 Fifth St, Area B Bldg 0840 WPAFB, OH 45433 - (937) 938-2523

Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
WRIGHT-PATTERSON AFB OH, 45433
Report Date: 5/10/2013 1:07:14 PM
Contact: Maj Alan Hale
Client Sample ID: GS130002
Lab Sample ID: S1302201-02A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
U-235		1.5E-1	5.E-2	4.E-2	7.E-2	pCi/g	TDR	04/23/13 1702	6282
TL-208		4.0E-1	4.E-2	2.E-2	5.E-2	pCi/g	TDR	04/23/13 1702	6282
TH-228		2.E0	2.E0	2.E0	3.E0	pCi/g	TDR	04/23/13 1702	6282
RA-226		2.3E0	7.E-1	6.E-1	1.2E0	pCi/g	TDR	04/23/13 1702	6282
RA-224		1.5E0	4.E-1	4.E-1	8.E-1	pCi/g	TDR	04/23/13 1702	6282
Ra_D_214		1.212E0	6.4E-2	4.9E-2	1.00E-1	pCi/g	TDR	04/23/13 1702	6282
PB-214		7.E-1	3.E-1	2.E-1	4.E-1	pCi/g	TDR	04/23/13 1702	6282
PB-212		1.41E0	7.E-2	4.E-2	8.E-2	pCi/g	TDR	04/23/13 1702	6282
K-40		1.7E1	1.E0	0.E0	1.E0	pCi/g	TDR	04/23/13 1702	6282
BI-212		1.2E0	4.E-1	3.E-1	6.E-1	pCi/g	TDR	04/23/13 1702	6282
AC-228		1.3E0	2.E-1	1.E-1	2.E-1	pCi/g	TDR	04/23/13 1702	6282

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Radioanalytical Services Laboratory
2510 Fifth St, Area B Bldg 0840 WPAFB, OH 45433 - (937) 938-2523

Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
WRIGHT-PATTERSON AFB OH, 45433
Report Date: 5/10/2013 1:07:14 PM
Contact: Maj Alan Hale
Client Sample ID: GS130003
Lab Sample ID: S1302201-03A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
CD-109	A, D, G, I	9.E-1	5.E-1	5.E-1	1.1E0	pCi/g	TDR	04/23/13 2303	6282
U-235		1.1E-1	5.E-2	4.E-2	9.E-2	pCi/g	TDR	04/23/13 2303	6282
TL-208		2.9E-1	4.E-2	2.E-2	5.E-2	pCi/g	TDR	04/23/13 2303	6282
TH-234		4.E0	2.E0	3.E0	6.E0	pCi/g	TDR	04/23/13 2303	6282
RA-226		1.7E0	8.E-1	7.E-1	1.4E0	pCi/g	TDR	04/23/13 2303	6282
RA-224		1.1E0	4.E-1	5.E-1	9.E-1	pCi/g	TDR	04/23/13 2303	6282
Ra_D_214		1.607E0	6.1E-2	4.3E-2	8.9E-2	pCi/g	TDR	04/23/13 2303	6282
PB-214		1.2E0	2.E-1	2.E-1	5.E-1	pCi/g	TDR	04/23/13 2303	6282
PB-212		1.06E0	6.E-2	4.E-2	9.E-2	pCi/g	TDR	04/23/13 2303	6282
K-40		1.5E1	1.E0	0.E0	1.E0	pCi/g	TDR	04/23/13 2303	6282
BI-212		7.E-1	4.E-1	3.E-1	7.E-1	pCi/g	TDR	04/23/13 2303	6282
AC-228		1.0E0	1.E-1	1.E-1	2.E-1	pCi/g	TDR	04/23/13 2303	6282

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2510 Fifth St, Area B Bldg 0840 WPAFB, OH 45433 - (937) 938-2523

Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
Report Date: 5/10/2013 1:07:14 PM
WRIGHT-PATTERSON AFB OH, 45433
Contact: Maj Alan Hale
Client Sample ID: GS130004
Lab Sample ID: S1302201-04A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
BA-133	A, D, G, I	7.E-2	3.E-2	2.1E-1	4.3E-1	pCi/g	TDR	04/24/13 504	6282
U-235		2.3E-1	5.E-2	4.E-2	8.E-2	pCi/g	TDR	04/24/13 504	6282
TL-208		4.3E-1	4.E-2	2.E-2	5.E-2	pCi/g	TDR	04/24/13 504	6282
TH-234		4.E0	3.E0	2.E0	5.E0	pCi/g	TDR	04/24/13 504	6282
TH-228		2.E0	1.E0	2.E0	3.E0	pCi/g	TDR	04/24/13 504	6282
RA-226		3.6E0	8.E-1	6.E-1	1.3E0	pCi/g	TDR	04/24/13 504	6282
RA-224		1.2E0	4.E-1	4.E-1	8.E-1	pCi/g	TDR	04/24/13 504	6282
Ra_D_214		2.222E0	7.2E-2	4.3E-2	8.9E-2	pCi/g	TDR	04/24/13 504	6282
PB-214		1.9E0	4.E-1	2.E-1	5.E-1	pCi/g	TDR	04/24/13 504	6282
PB-212		1.44E0	7.E-2	4.E-2	8.E-2	pCi/g	TDR	04/24/13 504	6282
K-40		1.8E1	1.E0	0.E0	1.E0	pCi/g	TDR	04/24/13 504	6282
BI-212		2.E0	1.E0	1.E0	2.E0	pCi/g	TDR	04/24/13 504	6282
AC-228		1.27E0	8.E-2	9.E-2	1.8E-1	pCi/g	TDR	04/24/13 504	6282

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Radioanalytical Services Laboratory
2510 Fifth St, Area B Bldg 0840 WPAFB, OH 45433 - (937) 938-2523

Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
WRIGHT-PATTERSON AFB OH, 45433
Report Date: 5/10/2013 1:07:14 PM
Contact: Maj Alan Hale
Client Sample ID: GS130005
Lab Sample ID: S1302201-05A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
TL-208		3.5E-1	5.E-2	3.E-2	6.E-2	pCi/g	TDR	04/24/13 1105	6282
TH-234		4.E0	3.E0	3.E0	6.E0	pCi/g	TDR	04/24/13 1105	6282
RA-226		6.E0	1.E0	1.E0	2.E0	pCi/g	TDR	04/24/13 1105	6282
RA-224		2.E0	1.E0	1.E0	1.E0	pCi/g	TDR	04/24/13 1105	6282
Ra_D_214		5.50E0	1.3E-1	6.E-2	1.3E-1	pCi/g	TDR	04/24/13 1105	6282
PB-214		5.6E0	6.E-1	3.E-1	6.E-1	pCi/g	TDR	04/24/13 1105	6282
PB-212		1.2E0	1.E-1	0.0E0	1.E-1	pCi/g	TDR	04/24/13 1105	6282
PB-210		9.E0	9.E0	7.E0	1.5E1	pCi/g	TDR	04/24/13 1105	6282
K-40		1.7E1	1.E0	0.E0	1.E0	pCi/g	TDR	04/24/13 1105	6282
BI-212		1.2E0	5.E-1	3.E-1	7.E-1	pCi/g	TDR	04/24/13 1105	6282
AC-228		1.3E0	1.E-1	1.E-1	2.E-1	pCi/g	TDR	04/24/13 1105	6282

BRIAN J STROH, Capt, USAF
Chief, Radioanalytical Laboratory

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Technical Director, Radioanalytical Laboratory



Radioanalytical Services Laboratory
2510 Fifth St, Area B Bldg 0840 WPAFB, OH 45433 - (937) 938-2523

Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
WRIGHT-PATTERSON AFB OH, 45433
Report Date: 5/10/2013 1:07:14 PM
Contact: Maj Alan Hale
Client Sample ID: GS130006
Lab Sample ID: S1302201-06A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
U-235		1.8E-1	5.E-2	4.E-2	9.E-2	pCi/g	TDR	04/24/13 1707	6282
TL-208		2.7E-1	4.E-2	2.E-2	5.E-2	pCi/g	TDR	04/24/13 1707	6282
TH-234		2.E0	2.E0	3.E0	6.E0	pCi/g	TDR	04/24/13 1707	6282
TH-232		2.0E1	2.0E1	2.0E1	3.0E1	pCi/g	TDR	04/24/13 1707	6282
RA-226		2.8E0	9.E-1	7.E-1	1.4E0	pCi/g	TDR	04/24/13 1707	6282
RA-224		1.0E0	4.E-1	4.E-1	9.E-1	pCi/g	TDR	04/24/13 1707	6282
Ra_D_214		1.953E0	7.E-2	4.7E-2	9.7E-2	pCi/g	TDR	04/24/13 1707	6282
PB-214		1.4E0	3.E-1	2.E-1	5.E-1	pCi/g	TDR	04/24/13 1707	6282
PB-212		1.10E0	6.E-2	4.E-2	8.E-2	pCi/g	TDR	04/24/13 1707	6282
K-40		1.3E1	1.E0	3.E-1	6.E-1	pCi/g	TDR	04/24/13 1707	6282
BI-212		1.0E0	4.E-1	3.E-1	6.E-1	pCi/g	TDR	04/24/13 1707	6282
AC-228		9.E-1	1.E-1	9.E-2	1.8E-1	pCi/g	TDR	04/24/13 1707	6282

BRIAN J STROH, Capt, USAF
Chief, Radioanalytical Laboratory

AURELIE M SOREFAN, DR-II, PhD, DAF
Technical Director, Radioanalytical Laboratory



Radioanalytical Services Laboratory
2510 Fifth St, Area B Bldg 0840 WPAFB, OH 45433 - (937) 938-2523

Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
WRIGHT-PATTERSON AFB OH, 45433
Report Date: 5/10/2013 1:07:14 PM
Contact: Maj Alan Hale
Client Sample ID: GS130007
Lab Sample ID: S1302201-07A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
TL-208		4.7E-1	5.E-2	5.E-2	1.0E-1	pCi/g	TDR	04/24/13 2308	6282
RA-226		3.3E1	3.E0	2.E0	5.E0	pCi/g	TDR	04/24/13 2308	6282
RA-224		6.E0	4.E0	1.E0	2.E0	pCi/g	TDR	04/24/13 2308	6282
Ra_D_214		2.908E1	4.4E-1	1.4E-1	2.9E-1	pCi/g	TDR	04/24/13 2308	6282
PB-214		3.05E1	9.E-1	7.E-1	1.3E0	pCi/g	TDR	04/24/13 2308	6282
PB-212		1.5E0	1.E-1	1.E-1	2.E-1	pCi/g	TDR	04/24/13 2308	6282
K-40		1.7E1	1.E0	1.E0	1.E0	pCi/g	TDR	04/24/13 2308	6282
Bi-214		2.64E1	4.8E0	8.5E0	1.72E1	pCi/g	TDR	04/24/13 2308	6282
Bi-212		1.4E0	5.E-1	6.E-1	1.3E0	pCi/g	TDR	04/24/13 2308	6282
AC-228		1.3E0	2.E-1	2.E-1	4.E-1	pCi/g	TDR	04/24/13 2308	6282

BRIAN J STROH, Capt, USAF
Chief, Radioanalytical Laboratory

AURELIE M SOREFAN, DR-II, PhD, DAF
Technical Director, Radioanalytical Laboratory



Radioanalytical Services Laboratory
2510 Fifth St, Area B Bldg 0840 WPAFB, OH 45433 - (937) 938-2523

Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
WRIGHT-PATTERSON AFB OH, 45433
Report Date: 5/10/2013 1:07:14 PM
Contact: Maj Alan Hale
Client Sample ID: GS130008
Lab Sample ID: S1302201-08A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
U-235		1.3E-1	5.E-2	4.E-2	8.E-2	pCi/g	TDR	04/25/13 509	6282
TL-208		3.2E-1	4.E-2	2.E-2	5.E-2	pCi/g	TDR	04/25/13 509	6282
TH-234		7.E0	2.E0	3.E0	6.E0	pCi/g	TDR	04/25/13 509	6282
TH-228		3.E0	1.E0	2.E0	3.E0	pCi/g	TDR	04/25/13 509	6282
RA-226		1.9E0	8.E-1	6.E-1	1.3E0	pCi/g	TDR	04/25/13 509	6282
RA-224		7.E-1	3.E-1	4.E-1	7.E-1	pCi/g	TDR	04/25/13 509	6282
Ra_D_214		1.078E0	4.9E-2	4.5E-2	9.2E-2	pCi/g	TDR	04/25/13 509	6282
PB-214		9.E-1	3.E-1	2.E-1	5.E-1	pCi/g	TDR	04/25/13 509	6282
PB-212		1.23E0	8.E-2	4.E-2	8.E-2	pCi/g	TDR	04/25/13 509	6282
K-40		1.9E1	1.E0	0.E0	1.E0	pCi/g	TDR	04/25/13 509	6282
BI-212		1.3E0	4.E-1	3.E-1	6.E-1	pCi/g	TDR	04/25/13 509	6282
AC-228		1.1E0	1.E-1	1.E-1	2.E-1	pCi/g	TDR	04/25/13 509	6282

BRIAN J STROH, Capt, USAF
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Technical Director, Radioanalytical Laboratory



Radioanalytical Services Laboratory
2510 Fifth St, Area B Bldg 0840 WPAFB, OH 45433 - (937) 938-2523

Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
WRIGHT-PATTERSON AFB OH, 45433
Report Date: 5/10/2013 1:07:14 PM
Contact: Maj Alan Hale
Client Sample ID: GS130009
Lab Sample ID: S1302201-09A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
TL-208		3.6E-1	4.E-2	3.E-2	5.E-2	pCi/g	TDR	04/25/13 1110	6282
TH-234		6.E0	3.E0	3.E0	7.E0	pCi/g	TDR	04/25/13 1110	6282
TH-228		1.E0	1.E0	2.E0	4.E0	pCi/g	TDR	04/25/13 1110	6282
RA-226		2.4E0	9.E-1	8.E-1	1.5E0	pCi/g	TDR	04/25/13 1110	6282
RA-224		7.E-1	6.E-1	5.E-1	1.0E0	pCi/g	TDR	04/25/13 1110	6282
Ra_D_214		1.857E0	7.1E-2	4.8E-2	1.00E-1	pCi/g	TDR	04/25/13 1110	6282
PB-214		1.2E0	4.E-1	3.E-1	5.E-1	pCi/g	TDR	04/25/13 1110	6282
PB-212		1.4E0	2.E-1	0.0E0	1.E-1	pCi/g	TDR	04/25/13 1110	6282
PA-234M		2.0E1	2.0E1	1.0E1	3.0E1	pCi/g	TDR	04/25/13 1110	6282
K-40		1.0E1	1.E0	0.E0	1.E0	pCi/g	TDR	04/25/13 1110	6282
Bi-214		8.4E0	5.4E0	4.7E0	9.5E0	pCi/g	TDR	04/25/13 1110	6282
Bi-212		1.5E0	4.E-1	3.E-1	7.E-1	pCi/g	TDR	04/25/13 1110	6282
AC-228		1.2E0	1.E-1	1.E-1	2.E-1	pCi/g	TDR	04/25/13 1110	6282

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AURELIE M SOREFAN, DR-II, PhD, DAF
Technical Director, Radioanalytical Laboratory



Radioanalytical Services Laboratory
2510 Fifth St, Area B Bldg 0840 WPAFB, OH 45433 - (937) 938-2523

Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
WRIGHT-PATTERSON AFB OH, 45433
Report Date: 5/10/2013 1:07:14 PM
Contact: Maj Alan Hale
Client Sample ID: GS130010
Lab Sample ID: S1302201-10A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
U-235		3.E-1	2.E-1	1.E-1	1.E-1	pCi/g	TDR	04/25/13 1712	6282
TL-208		3.0E-1	4.E-2	3.E-2	6.E-2	pCi/g	TDR	04/25/13 1712	6282
RA-226		4.E0	3.E0	1.E0	2.E0	pCi/g	TDR	04/25/13 1712	6282
RA-224		3.E0	1.E0	1.E0	1.E0	pCi/g	TDR	04/25/13 1712	6282
Ra_D_214		5.70E0	1.2E-1	8.E-2	1.6E-1	pCi/g	TDR	04/25/13 1712	6282
PB-214		5.6E0	6.E-1	3.E-1	6.E-1	pCi/g	TDR	04/25/13 1712	6282
PB-212		1.2E0	1.E-1	1.E-1	1.E-1	pCi/g	TDR	04/25/13 1712	6282
PB-210		1.1E1	8.E0	7.E0	1.3E1	pCi/g	TDR	04/25/13 1712	6282
K-40		1.7E1	1.E0	0.E0	1.E0	pCi/g	TDR	04/25/13 1712	6282
BI-212		1.2E0	5.E-1	4.E-1	8.E-1	pCi/g	TDR	04/25/13 1712	6282
AC-228		1.0E0	1.E-1	1.E-1	3.E-1	pCi/g	TDR	04/25/13 1712	6282

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Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
Report Date: 5/10/2013 1:07:14 PM
WRIGHT-PATTERSON AFB OH, 45433
Contact: Maj Alan Hale
Client Sample ID: GS130011
Lab Sample ID: S1302201-11A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
U-235		2.4E-1	6.E-2	5.E-2	9.E-2	pCi/g	TDR	04/23/13 1805	6283
TL-208		4.7E-1	7.E-2	5.E-2	1.0E-1	pCi/g	TDR	04/23/13 1805	6283
TH-228		1.E0	1.E0	2.E0	4.E0	pCi/g	TDR	04/23/13 1805	6283
RA-226		3.7E0	9.E-1	7.E-1	1.5E0	pCi/g	TDR	04/23/13 1805	6283
RA-224		1.E0	1.E0	1.E0	1.E0	pCi/g	TDR	04/23/13 1805	6283
Ra_D_214		3.460E0	9.9E-2	5.8E-2	1.19E-1	pCi/g	TDR	04/23/13 1805	6283
PB-214		3.2E0	4.E-1	3.E-1	5.E-1	pCi/g	TDR	04/23/13 1805	6283
PB-212		1.3E0	2.E-1	1.E-1	1.E-1	pCi/g	TDR	04/23/13 1805	6283
K-40		1.5E1	1.E0	0.E0	1.E0	pCi/g	TDR	04/23/13 1805	6283
Bi-214		6.9E0	6.1E0	4.8E0	9.6E0	pCi/g	TDR	04/23/13 1805	6283
Bi-212		1.0E0	4.E-1	3.E-1	7.E-1	pCi/g	TDR	04/23/13 1805	6283
AC-228		1.1E0	1.E-1	1.E-1	2.E-1	pCi/g	TDR	04/23/13 1805	6283

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Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
WRIGHT-PATTERSON AFB OH, 45433
Report Date: 5/10/2013 1:07:14 PM
Contact: Maj Alan Hale
Client Sample ID: GS130012
Lab Sample ID: S1302201-12A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
TL-208		3.3E-1	4.E-2	3.E-2	6.E-2	pCi/g	TDR	04/24/13 007	6283
RA-226		8.E0	1.E0	1.E0	2.E0	pCi/g	TDR	04/24/13 007	6283
RA-224		2.E0	1.E0	1.E0	1.E0	pCi/g	TDR	04/24/13 007	6283
Ra_D_214		5.62E0	1.5E-1	6.E-2	1.2E-1	pCi/g	TDR	04/24/13 007	6283
PB-214		5.8E0	4.E-1	3.E-1	6.E-1	pCi/g	TDR	04/24/13 007	6283
PB-212		1.2E0	1.E-1	1.E-1	1.E-1	pCi/g	TDR	04/24/13 007	6283
K-40		1.6E1	1.E0	0.E0	1.E0	pCi/g	TDR	04/24/13 007	6283
Bi-214		-1.27E1	4.7E0	5.3E0	1.07E1	pCi/g	TDR	04/24/13 007	6283
Bi-212		1.2E0	5.E-1	4.E-1	8.E-1	pCi/g	TDR	04/24/13 007	6283
AC-228		9.9E-1	9.E-2	1.1E-1	2.2E-1	pCi/g	TDR	04/24/13 007	6283

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Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
WRIGHT-PATTERSON AFB OH, 45433
Report Date: 5/10/2013 1:07:14 PM
Contact: Maj Alan Hale
Client Sample ID: GS130013
Lab Sample ID: S1302201-13A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
TL-208		3.4E-1	5.E-2	4.E-2	9.E-2	pCi/g	TDR	04/24/13 608	6283
TH-234		2.E0	2.E0	3.E0	5.E0	pCi/g	TDR	04/24/13 608	6283
RA-226		5.E0	1.E0	7.E-1	2.E0	pCi/g	TDR	04/24/13 608	6283
RA-224		2.E0	1.E0	0.E0	1.E0	pCi/g	TDR	04/24/13 608	6283
Ra_D_214		3.88E0	1.1E-1	5.E-2	1.1E-1	pCi/g	TDR	04/24/13 608	6283
PB-214		3.7E0	5.E-1	3.E-1	5.E-1	pCi/g	TDR	04/24/13 608	6283
PB-212		1.1E0	1.E-1	1.E-1	1.E-1	pCi/g	TDR	04/24/13 608	6283
K-40		1.6E1	1.E0	0.E0	1.E0	pCi/g	TDR	04/24/13 608	6283
Bi-214		3.7E0	1.9E0	3.3E0	6.7E0	pCi/g	TDR	04/24/13 608	6283
Bi-212		1.4E0	4.E-1	3.E-1	7.E-1	pCi/g	TDR	04/24/13 608	6283
AC-228		1.1E0	1.E-1	1.E-1	2.E-1	pCi/g	TDR	04/24/13 608	6283

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Certificate of Analysis

Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
Report Date: 5/10/2013 1:07:14 PM
WRIGHT-PATTERSON AFB OH, 45433
Contact: Maj Alan Hale
Client Sample ID: GS130014
Lab Sample ID: S1302201-14A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
TL-208		5.E-1	1.E-1	1.E-1	1.E-1	pCi/g	TDR	04/24/13 1210	6283
TH-228		1.0E1	3.E0	4.E0	9.E0	pCi/g	TDR	04/24/13 1210	6283
RA-226		6.4E1	5.E0	3.E0	6.E0	pCi/g	TDR	04/24/13 1210	6283
Ra_D_214		5.634E1	6.9E-1	1.2E-1	2.5E-1	pCi/g	TDR	04/24/13 1210	6283
PB-214		5.8E1	2.E0	1.E0	1.E0	pCi/g	TDR	04/24/13 1210	6283
PB-212		1.3E0	1.E-1	1.E-1	2.E-1	pCi/g	TDR	04/24/13 1210	6283
PB-210		2.0E1	1.0E1	1.0E1	2.0E1	pCi/g	TDR	04/24/13 1210	6283
K-40		1.5E1	1.E0	1.E0	2.E0	pCi/g	TDR	04/24/13 1210	6283
Bi-214		5.40E1	6.2E0	8.4E0	1.69E1	pCi/g	TDR	04/24/13 1210	6283
Bi-212		2.E0	2.E0	1.E0	2.E0	pCi/g	TDR	04/24/13 1210	6283
AC-228		1.4E0	2.E-1	4.E-1	8.E-1	pCi/g	TDR	04/24/13 1210	6283

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Company: USAFSAM/OEC
Address: 2510 Fifth St. Bldg. 840
Report Date: 5/10/2013 1:07:14 PM
WRIGHT-PATTERSON AFB OH, 45433
Contact: Maj Alan Hale
Client Sample ID: GS130015
Lab Sample ID: S1302201-15A
Matrix: Soil
Client ID: 02060C
Collection Date: 2/22/2013
Receive Date: 2/25/2013
Collector: Client

Parameter	Qualifier	Activity	Uncertainty	Lc	MDA	Units	Analyst	Date/Time	Batch
Gamma Spec Full									
CD-109	C	7.E-1	6.E-1	5.E-1	1.0E0	pCi/g	TDR	04/24/13 1812	6283
U-235		1.0E-1	7.E-2	6.E-2	1.2E-1	pCi/g	TDR	04/24/13 1812	6283
TL-208		3.6E-1	4.E-2	2.E-2	5.E-2	pCi/g	TDR	04/24/13 1812	6283
TH-234		7.E0	2.E0	2.E0	4.E0	pCi/g	TDR	04/24/13 1812	6283
TH-228		2.E0	1.E0	1.E0	3.E0	pCi/g	TDR	04/24/13 1812	6283
RA-226		2.E0	1.E0	1.E0	2.E0	pCi/g	TDR	04/24/13 1812	6283
RA-224		8.E-1	4.E-1	4.E-1	7.E-1	pCi/g	TDR	04/24/13 1812	6283
Ra_D_214		8.08E-1	4.9E-2	4.1E-2	8.5E-2	pCi/g	TDR	04/24/13 1812	6283
PB-214		5.E-1	6.E-1	2.E-1	4.E-1	pCi/g	TDR	04/24/13 1812	6283
PB-212		1.1E0	1.E-1	0.0E0	1.E-1	pCi/g	TDR	04/24/13 1812	6283
K-40		1.5E1	1.E0	0.E0	1.E0	pCi/g	TDR	04/24/13 1812	6283
Bi-214		5.1E0	5.3E0	3.0E0	6.1E0	pCi/g	TDR	04/24/13 1812	6283
Bi-212		1.0E0	3.E-1	3.E-1	5.E-1	pCi/g	TDR	04/24/13 1812	6283
AC-228		1.14E0	7.E-2	8.E-2	1.7E-1	pCi/g	TDR	04/24/13 1812	6283

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Radiation Qualifier List

Qualifier	Qualifier Description
A	Identification Rejected
B	(ELAP) Blank Contamination
C	Inconclusive
D	Misidentification
E	False Positive
F	Consistent with False Positive
G	Background
H	Consistent with detector background
I	Inconsistent energy shift
J	(ELAP) The reported results is an estimated value
N	(ELAP) Non-target analyte
Q	(ELAP) One or more quality control criteria failed
U	(ELAP) Analyte was not detected and is reported as less than the LOD
K	Inconsistent Full Width Half Max (FWHM)